L Number	Hits	Search Text	DB	Time stamp
1	0	(magnetic adj recording adj layer) and (superconducting adj layer) and ((thermal or insulation) adj layer)	USPAT; EPO; JPO	2004/06/17 11:07
2	0	(magnetic adj recording adj layer) and (superconducting adj layer) and (thermal or insulation)	USPAT; EPO; JPO	2004/06/17 11:08
3	8	(magnetic adj recording) and (superconducting adj layer) and (thermal or insulation)	USPAT; EPO; JPO	2004/06/17 11:14
4	5	(magnetic adj layer) and (superconducting adj layer) and ((insulating or insulation) adj layer)	USPAT	2004/06/17 11:17
5	7	(magnetic adj layer) and (superconducting adj layer) and (heat or insulating or insulation)	USPAT	2004/06/17 11:20
6	45	(magnetic adj layer) and (superconducting) and (heat or insulating or insulation)	USPAT	2004/06/17 11:24
7	5	(magnetic adj layer) and (superconducting adj layer) and recording	USPAT	2004/06/17 11:25

	U	1	Document ID	Issue Date	Pages
1	☐	☐	US 5153798 A	19921006	4
2	☐	☐	US 5114913 A	19920519	9
3	☐	☐	US 5097243 A	19920317	7
4	☐	☐	US 5075280 A	19911224	13
5	☐	☐	US 4996621 A	19910226	10
6	☐	☐	US 4937227 A	19900626	5
7	☐	☐	US 4927804 A	19900522	7
8	☐	☐	US 4907115 A	19900306	5

	Title	Current OR	Current XRef
1	Magnetic head including a core having a non-magnetic gap	360/120	360/122; 505/826
2	Magnetic head slider employing superconductor for levitation	505/171	360/122; 360/235.1; 360/235.2
3	Thin-film transformer utilizing superconductive components	505/211	323/360; 335/216; 336/200; 336/DIG.1; 505/870
4	Thin film magnetic head with improved flux concentration for high density recording/playback utilizing superconductors	505/171	360/119; 360/126; 360/129
5	Superconducting device for reading information from a magnetic recording medium	360/126	324/248; 505/845
6	Thin-film magnetic head including an inductive transducing element	505/171	360/120; 360/126; 360/127; 505/701
7	Thin-film transformer and magnetic head provided with such a transformer	505/171	336/84R; 360/120; 360/126; 360/127
8	Super conducting thin-film magnetic head including a magnetoresistive element	360/321	360/126; 360/319; 505/872

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Ruigrok, Jacobus J. M. et al.	☒	☐	☐	☐	☐	☐	☐
2		Coufal, Hans J. et al.	☒	☐	☐	☐	☐	☐	☐
3		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
4		Pisharody, Raghavan K. et al.	☒	☐	☐	☐	☐	☐	☐
5		Ruigrok, Jacobus J. M. et al.	☒	☐	☐	☐	☐	☐	☐
6		Enz, Ulrich E. et al.	☒	☐	☐	☐	☐	☐	☐
7		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
8		Ruigrok, Jacobus J. M. et al.	☒	☐	☐	☐	☐	☐	☐

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1	US 5153798	☐
2	US 5114913	☐
3	US 5097243	☐
4	US 5075280	☐
5	US 4996621	☐
6	US 4937227	☐
7	US 4927804	☐
8	US 4907115	☐

	U	1	Document ID	Issue Date	Pages
1	☐	☐	US 6417458 B1	20020709	9
2	☐	☐	US 5719545 A	19980217	7
3	☐	☐	US 5097243 A	19920317	7
4	☐	☐	US 4937227 A	19900626	5
5	☐	☐	US 4927804 A	19900522	7

	Title	Current OR	Current XRef
1	Superconducting cable for alternating current	174/125.1	29/599; 505/230; 505/231; 505/232
2	High power factor shielded superconducting transformer	336/180	336/187; 336/200; 336/216; 336/83
3	Thin-film transformer utilizing superconductive components	505/211	323/360; 335/216; 336/200; 336/DIG.1; 505/870
4	Thin-film magnetic head including an inductive transducing element	505/171	360/120; 360/126; 360/127; 505/701
5	Thin-film transformer and magnetic head provided with such a transformer	505/171	336/84R; 360/120; 360/126; 360/127

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Mukoyama, Shinichi et al.	☒	☐	☐	☐	☐	☐	☐
2		Johnson, Leopold J.	☒	☐	☐	☐	☐	☐	☐
3		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
4		Enz, Ulrich E. et al.	☒	☐	☐	☐	☐	☐	☐
5		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐

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1	US 6417458	☐
2	US 5719545	☐
3	US 5097243	☐
4	US 4937227	☐
5	US 4927804	☐

	U	1	Document ID	Issue Date	Pages
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2	☐	☐	US 5728481 A	19980317	15
3	☐	☐	US 5719545 A	19980217	7
4	☐	☐	US 5109312 A	19920428	15
5	☐	☐	US 5097243 A	19920317	7

	Title	Current OR	Current XRef
1	Superconducting cable for alternating current	174/125.1	29/599; 505/230; 505/231; 505/232
2	Spin interaction device	428/694ML	428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238
3	High power factor shielded superconducting transformer	336/180	336/187; 336/200; 336/216; 336/83
4	Magnetic recording apparatus and magnetic head with superconducting material	505/171	360/125; 360/126; 505/701; 505/872
5	Thin-film transformer utilizing superconductive components	505/211	323/360; 335/216; 336/200; 336/DIG.1; 505/870

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Mukoyama, Shinichi et al.	☒	☐	☐	☐	☐	☐	☐
2		Kasai, Masahiro et al.	☒	☐	☐	☐	☐	☐	☐
3		Johnson, Leopold J.	☒	☐	☐	☐	☐	☐	☐
4		Kato, Takahiko et al.	☒	☐	☐	☐	☐	☐	☐
5		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐

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2	US 5728481	☐
3	US 5719545	☐
4	US 5109312	☐
5	US 5097243	☐

	U	1	Document ID	Issue Date	Pages
6	☐	☐	US 4937227 A	19900626	5
7	☐	☐	US 4927804 A	19900522	7

	Title	Current OR	Current XRef
6	Thin-film magnetic head including an inductive transducing element	505/171	360/120; 360/126; 360/127; 505/701
7	Thin-film transformer and magnetic head provided with such a transformer	505/171	336/84R; 360/120; 360/126; 360/127

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
6		Enz, Ulrich E. et al.	☒	☐	☐	☐	☐	☐	☐
7		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐

	Image Doc. Displayed	PT
6	US 4937227	☐
7	US 4927804	☐

US005904979A

United States Patent [19]

Kakuishi et al.

[11] **Patent Number: 5,904,979**

[45] **Date of Patent: *May 18, 1999**

[54] **MAGNETIC RECORDING SYSTEM**

[75] Inventors: **Yutaka Kakuishi; Kenichi Masuyama; Kiyomi Ejiri,** all of Kanagawa, Japan

[73] Assignee: **Fuji Photo Film Co., Ltd.,** Kanagawa, Japan

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/602,567**

[22] Filed: **Feb. 14, 1996**

[30] **Foreign Application Priority Data**

Feb. 21, 1995 [JP] Japan 7-055174

[51] **Int. Cl.**[6] **G11B 05/712**

[52] **U.S. Cl.** ..... **428/328**; 428/336; 428/403; 428/522; 428/694 BS; 428/694 BA; 428/900

[58] **Field of Search** ..... 360/88, 97.01, 360/113; 428/328, 336, 403, 522, 694 BS, 694 BA, 900

[56] **References Cited**

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5,082,733	1/1992	Watanabe et al.	428/403
5,176,955	1/1993	Ejiri et al.	428/336
5,244,736	9/1993	Hashimoto et al.	428/403
5,390,061	2/1995	Nakatani et al.	360/113

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Primary Examiner—Stevan A. Resan

Attorney, Agent, or Firm—Sughrue, Mion, Zinn, Macpeak & Seas, PLLC

[57] **ABSTRACT**

(1) A magnetic recording system is disclosed, which comprises a thin-film magnetic head and a magnetic recording medium comprising a nonmagnetic support having thereon a magnetic layer comprising mainly ferromagnetic particles and a binder resin, wherein said binder resin comprising mainly a vinyl chloride resin, and said ferromagnetic particles are surface-treated with at least an organic compound. (2) Another magnetic recording system is disclosed, which comprises a thin-film magnetic head and a magnetic recording medium comprising a nonmagnetic support, a nonmagnetic layer comprising mainly inorganic nonmagnetic particles and a binder resin over the nonmagnetic support, and a magnetic layer comprising mainly ferromagnetic metal particles and a binder resin over the nonmagnetic layer, wherein said binder resins in said magnetic and nonmagnetic layers each comprises mainly a vinyl chloride resin, said ferromagnetic metal particles are surface-treated with at least an organic compound, and said magnetic layer has a thickness of from 0.05 to 1.0 μm.

18 Claims, No Drawings

	U	1	Document ID	Issue Date	Pages
1	☐	☐	US 6730395 B2	20040504	10
2	☐	☐	US 6674662 B1	20040106	25
3	☐	☐	US 6657431 B2	20031202	19
4	☐	☐	US 6613385 B2	20030902	7
5	☐	☐	US 6535365 B1	20030318	15
6	☐	☐	US 6417561 B1	20020709	25
7	☐	☐	US 6417458 B1	20020709	9
8	☐	☐	US 6413788 B1	20020702	24

	Title	Current OR	Current XRef
1	Magnetic tunnel junction using nanoparticle monolayers and applications therefor	428/323	360/324; 360/324.2; 427/130; 428/457; 428/692; 428/693
2	Magnetoresistive random access memory and method for reading/writing digital information to such a memory	365/158	365/171; 365/173
3	Scanning magnetic microscope having improved magnetic sensor	324/244	324/210; 324/252; 324/750
4	Highly spin-polarized chromium dioxide thin films prepared by CVD using chromyl chloride precursor	427/255.31	427/255.36; 427/255.7
5	Magnetic tunneling structure having ferromagnetic layers of different crystallographic structure	360/324.2	
6	Keepers for MRAM electrodes	257/659	257/295; 257/390; 438/3
7	Superconducting cable for alternating current	174/125.1	29/599; 505/230; 505/231; 505/232
8	Keepers for MRAM electrodes	438/3	257/326; 438/692

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Covington, Mark William	☒	☐	☐	☐	☐	☐	☐
2		Hillebrands, Burkard et al.	☒	☐	☐	☐	☐	☐	☐
3		Xiao, Gang	☒	☐	☐	☐	☐	☐	☐
4		Desito, William J.	☒	☐	☐	☐	☐	☐	☐
5		Lukaszew, Rosa A. et al.	☒	☐	☐	☐	☐	☐	☐
6		Tuttle, Mark E.	☒	☐	☐	☐	☐	☐	☐
7		Mukoyama, Shinichi et al.	☒	☐	☐	☐	☐	☐	☐
8		Tuttle, Mark E.	☒	☐	☐	☐	☐	☐	☐

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2	US 6674662	☐
3	US 6657431	☐
4	US 6613385	☐
5	US 6535365	☐
6	US 6417561	☐
7	US 6417458	☐
8	US 6413788	☐

	U	1	Document ID	Issue Date	Pages
9	☐	☐	US 6410923 B1	20020625	32
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11	☐	☐	US 6307241 B1	20011023	10
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13	☐	☐	US 6110609 A	20000829	16
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15	☐	☐	US 6051839 A	20000418	31
16	☐	☐	US 5961848 A	19991005	15

	Title	Current OR	Current XRef
9	Magnetic lens apparatus for use in high-resolution scanning electron microscopes and lithographic processes	250/396ML	250/310; 250/398
10	Heat transfer apparatus and method employing active regenerative cycle	62/6	62/467
11	Integrable ferromagnets for high density storage	257/421	257/425; 257/431
12	Non-volatile MEMS micro-relays using magnetic actuators	310/40MM	310/DIG.6; 335/128; 335/78; 335/79; 335/80
13	Magnetic thin film and magnetic head using the same	428/692	324/252; 360/128; 428/694R; 428/694T; 428/694TS; 428/900
14	Method and apparatus for cooling GMR heads for magnetic hard disks	62/259.2	62/3.2; 62/3.7
15	Magnetic lens apparatus for use in high-resolution scanning electron microscopes and lithographic processes	250/396ML	250/310; 250/311
16	Process for producing magnetoresistive transducers	216/22	257/E43.006; 29/603.01

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
9		Crewe, Albert V.	☒	☐	☐	☐	☐	☐	☐
10		Reid, Christopher E. J. et al.	☒	☐	☐	☐	☐	☐	☐
11		Awschalom, David D. et al.	☒	☐	☐	☐	☐	☐	☐
12		Bishop, David John et al.	☒	☐	☐	☐	☐	☐	☐
13		Hiramoto, Masayoshi et al.	☒	☐	☐	☐	☐	☐	☐
14		Ghoshal, Uttam Shyamalindu	☒	☐	☐	☐	☐	☐	☐
15		Crewe, Albert V.	☒	☐	☐	☐	☐	☐	☐
16		Jacquet, Jean-Claude et al.	☒	☐	☐	☐	☐	☐	☐

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9	US 6410923	☐
10	US 6332323	☐
11	US 6307241	☐
12	US 6124650	☐
13	US 6110609	☐
14	US 6105381	☐
15	US 6051839	☐
16	US 5961848	☐

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21	☐	☐	US 5841692 A	19981124	20
22	☐	☐	US 5764567 A	19980609	22

	Title	Current OR	Current XRef
17	Self-aligned wordline keeper and method of manufacture therefor	365/158	365/171; 365/173
18	Magnetic recording system	428/328	428/336; 428/403; 428/522; 428/694BA; 428/694BS; 428/900
19	Magnetic field responsive device having giant magnetoresistive material and method for forming the same	324/252	360/326
20	Copolymers having magnetic properties	528/422	528/210; 528/271; 528/327; 528/331; 528/391; 528/399
21	Magnetic tunnel junction device with antiferromagnetically coupled pinned layer	365/173	257/E45.001; 365/158
22	Magnetic tunnel junction device with nonferromagnetic interface layer for improved magnetic field response	365/173	257/E45.001; 365/171

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
17		Hurst, Allan T. et al.	☒	☐	☐	☐	☐	☐	☐
18		Kakuishi, Yutaka et al.	☒	☐	☐	☐	☐	☐	☐
19		Gibbs, Michael Richard John et al.	☒	☐	☐	☐	☐	☐	☐
20		Galaj, Stanislas et al.	☒	☐	☐	☐	☐	☐	☐
21		Gallagher, William Joseph et al.	☒	☐	☐	☐	☐	☐	☐
22		Parkin, Stuart Stephen Papworth	☒	☐	☐	☐	☐	☐	☐

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18	US 5904979	☐
19	US 5886523	☐
20	US 5844069	☐
21	US 5841692	☐
22	US 5764567	☐

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	Title	Current OR	Current XRef
23	Spin interaction device	428/694ML	428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238
24	High power factor shielded superconducting transformer	336/180	336/187; 336/200; 336/216; 336/83
25	Magnetic recording medium	428/694B	428/694BA; 428/694BM; 428/694BN; 428/694BS; 428/900
26	Magnetic device and method for locally controllably altering magnetization direction	360/324.2	360/126
27	Magnetic tunnel junctions with controlled magnetic response	365/173	257/E45.001; 365/171

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
23		Kasai, Masahiro et al.	☒	☐	☐	☐	☐	☐	☐
24		Johnson, Leopold J.	☒	☐	☐	☐	☐	☐	☐
25		Yamazaki, Nobuo et al.	☒	☐	☐	☐	☐	☐	☐
26		Johnson, Mark T. et al.	☒	☐	☐	☐	☐	☐	☐
27		Gallagher, William Joseph et al.	☒	☐	☐	☐	☐	☐	☐

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24	US 5719545	☐
25	US 5714275	☐
26	US 5691865	☐
27	US 5650958	☐

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29	☐	☐	US 5632942 A	19970527	9
30	☐	☐	US 5601916 A	19970211	13
31	☐	☐	US 5567523 A	19961022	13

	Title	Current OR	Current XRef
28	Magnetic heads and magnetic recording reproducing devices using magnetic laminations	428/332	428/336; 428/694EC; 428/694IS; 428/694MM; 428/694R; 428/694TM; 428/694TS; 428/900
29	Method for preparing multilayer ceramic/glass substrates with electromagnetic shielding	156/89.17	156/89.18; 156/89.19; 156/89.21; 264/619; 427/131; 427/132; 428/426
30	Magnetic recording medium having a magnetic layer comprising hexagonal ferrite particles	428/329	428/336; 428/694BH; 428/694BM; 428/694BS; 428/900
31	Magnetic recording medium comprising a carbon substrate, a silicon or aluminum nitride sub layer, and a barium hexaferrite magnetic layer	428/408	428/694ST; 428/694TS; 428/900

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
28		Mitsuoka, Katsuya et al.	☒	☐	☐	☐	☐	☐	☐
29		Yeh, Tsung-Shou et al.	☒	☐	☐	☐	☐	☐	☐
30		Yamazaki, Nobuo et al.	☒	☐	☐	☐	☐	☐	☐
31		Rosenblum, Stephen S. et al.	☒	☐	☐	☐	☐	☐	☐

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29	US 5632942	☐
30	US 5601916	☐
31	US 5567523	☐

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34	☐	☐	US 5466431 A	19951114	13
35	☐	☐	US 5408034 A	19950418	15

	Title	Current OR	Current XRef
32	Amorphous uranium alloy and use thereof	428/694ML	365/122; 369/13.02; 369/13.35; 369/14; 420/1; 420/3; 420/576; 428/692; 428/694MT; 428/694RE; 428/694SC; 428/900
33	Superconductor magnetic reading and writing heads	505/171	360/120; 360/125
34	Diamond-like metallic nanocomposites	423/446	117/929; 423/415.1; 427/122; 428/408; 501/99
35	Copolymers having magnetic properties	528/422	528/271; 528/331; 528/391; 528/399

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
32		Gambino, Richard J. et al.	☒	☐	☐	☐	☐	☐	☐
33		Barnes, Frank S. et al.	☒	☐	☐	☐	☐	☐	☐
34		Dorfman, Veniamin et al.	☒	☐	☐	☐	☐	☐	☐
35		Galaj, Stanislas et al.	☒	☐	☐	☐	☐	☐	☐

	Image Doc. Displayed	PT
32	US 5534360	☐
33	US RE35212	☐
34	US 5466431	☐
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37	☐	☐	US 5109312 A	19920428	15
38	☐	☐	US 5097243 A	19920317	7
39	☐	☐	US 5066637 A	19911119	8
40	☐	☐	US 4971947 A	19901120	12

	Title	Current OR	Current XRef
36	Method for forming diamond-like nanocomposite or doped-diamond-like nanocomposite films	427/530	347/62; 423/446; 427/122; 427/570; 427/573; 427/574; 427/577; 427/578; 427/62; 427/905; 427/906; 428/408
37	Magnetic recording apparatus and magnetic head with superconducting material	505/171	360/125; 360/126; 505/701; 505/872
38	Thin-film transformer utilizing superconductive components	505/211	323/360; 335/216; 336/200; 336/DIG.1; 505/870
39	Gyromagnetic-effect cryogenic gyroscope for detecting angular velocity	505/160	324/160; 324/163; 324/248; 505/842; 505/872; 73/504.02; 74/5R
40	Superconductor magnetic reading and writing heads	505/171	360/120; 360/125

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
36		Dorfman, Veniamin et al.	☒	☐	☐	☐	☐	☐	☐
37		Kato, Takahiko et al.	☒	☐	☐	☐	☐	☐	☐
38		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
39		Cerdonio, Massimo et al.	☒	☐	☐	☐	☐	☐	☐
40		Barnes, Frank S. et al.	☒	☐	☐	☐	☐	☐	☐

	Image Doc. Displayed	PT
36	US 5352493	☐
37	US 5109312	☐
38	US 5097243	☐
39	US 5066637	☐
40	US 4971947	☐

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41	☐	☐	US 4937227 A	19900626	5
42	☐	☐	US 4927804 A	19900522	7
43	☐	☐	US 4902428 A	19900220	7
44	☐	☐	US 4012756 A	19770315	14
45	☐	☐	US 3691539 A	19720912	4

	Title	Current OR	Current XRef
41	Thin-film magnetic head including an inductive transducing element	505/171	360/120; 360/126; 360/127; 505/701
42	Thin-film transformer and magnetic head provided with such a transformer	505/171	336/84R; 360/120; 360/126; 360/127
43	Method and apparatus for separating magnetic material	210/695	209/214; 209/223.1; 209/232; 210/222; 95/28; 96/2
44	Method of inhibiting hillock formation in films and film thereby and multilayer structure therewith	257/32	257/734; 257/E21.295; 257/E21.591; 257/E23.157; 257/E23.159; 327/528; 505/874
45	SUPERCONDUCTIVE DEVICE FOR ELECTRONIC STORAGE OF LARGE QUANTITIES OF DATA USING MAGNETIC PARTICLES	365/160	327/528; 505/832

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
41		Enz, Ulrich E. et al.	☒	☐	☐	☐	☐	☐	☐
42		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
43		Cohen, Henry E.	☒	☐	☐	☐	☐	☐	☐
44		Chaudhari, Praveen et al.	☒	☐	☐	☐	☐	☐	☐
45		Erben, Klaus Dieter et al.	☒	☐	☐	☐	☐	☐	☐

	Image Doc. Displayed	PT
41	US 4937227	☐
42	US 4927804	☐
43	US 4902428	☐
44	US 4012756	☐
45	US 3691539	☐

	U	1	Document ID	Issue Date	Pages
1	☐	☐	US 5728481 A	19980317	15
2	☐	☐	US 5109312 A	19920428	15
3	☐	☐	US 5097243 A	19920317	7
4	☐	☐	US 4937227 A	19900626	5
5	☐	☐	US 4927804 A	19900522	7

	Title	Current OR	Current XRef
1	Spin interaction device	428/694ML	428/694IS; 428/694MM; 428/694RE; 428/694SC; 428/694TM; 428/701; 428/702; 428/900; 501/126; 501/152; 505/190; 505/238
2	Magnetic recording apparatus and magnetic head with superconducting material	505/171	360/125; 360/126; 505/701; 505/872
3	Thin-film transformer utilizing superconductive components	505/211	323/360; 335/216; 336/200; 336/DIG.1; 505/870
4	Thin-film magnetic head including an inductive transducing element	505/171	360/120; 360/126; 360/127; 505/701
5	Thin-film transformer and magnetic head provided with such a transformer	505/171	336/84R; 360/120; 360/126; 360/127

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Kasai, Masahiro et al.	☒	☐	☐	☐	☐	☐	☐
2		Kato, Takahiko et al.	☒	☐	☐	☐	☐	☐	☐
3		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐
4		Enz, Ulrich E. et al.	☒	☐	☐	☐	☐	☐	☐
5		Zieren, Victor et al.	☒	☐	☐	☐	☐	☐	☐

	Image Doc. Displayed	PT
1	US 5728481	☐
2	US 5109312	☐
3	US 5097243	☐
4	US 4937227	☐
5	US 4927804	☐

United States Patent [19]

Ruigrok et al.

[11] **Patent Number: 4,907,115**

[45] **Date of Patent: Mar. 6, 1990**

[54] **SUPER CONDUCTING THIN-FILM MAGNETIC HEAD INCLUDING A MAGNETORESISTIVE ELEMENT**

[75] Inventors: **Jacobus J. M. Ruigrok; Victor Zieren**, both of Eindhoven, Netherlands

[73] Assignee: **U.S. Philips Corp.**, New York, N.Y.

[21] Appl. No.: **218,009**

[22] Filed: **Jul. 12, 1988**

[30] **Foreign Application Priority Data**

Jul. 15, 1987 [NL] Netherlands 8701663

[51] **Int. Cl.**[4] **G11B 5/30**

[52] **U.S. Cl.** **360/113**; 360/126; 505/872

[58] **Field of Search** 360/113, 126; 505/872, 505/845, 846

[56] **References Cited**

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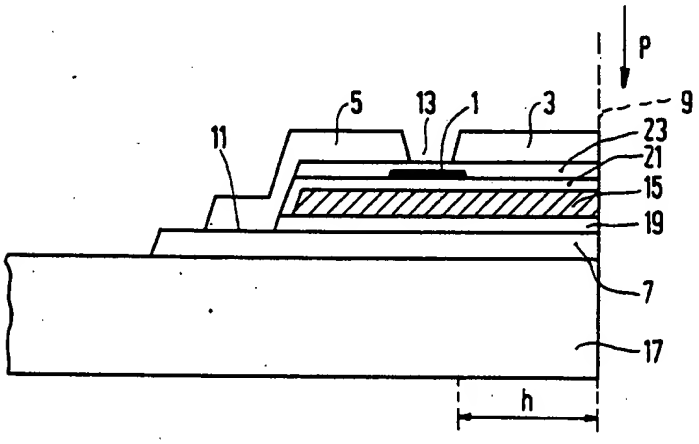
0122660 10/1984 European Pat. Off. .
1522971 10/1969 Fed. Rep. of Germany .
56-145514 11/1981 Japan .
56-156914 12/1981 Japan .
60-154315 8/1985 Japan .
2146481 4/1985 United Kingdom .

Primary Examiner—A. J. Heinz
Attorney, Agent, or Firm—William L. Botjer

[57] **ABSTRACT**

Thin-film magnetic head including a magnetoresistive element (1) and a face (9) for magnetically coupling the element with a magnetic recording medium. A magnetic yoke constituted by three layers (3, 5, 7) of a magnetically permeable material has a gap (13) which is bridged by the magnetoresistive element. A layer (15) of a superconducting material for improving the efficiency of the magnetic head is provided between the layers (3) and (5) and the element (1) on the one hand and the layer (7) on the other hand. For protection from external disturbing magnetic fields and reduction of stray flux a layer (43A, 43B, respectively) of a superconducting material is provided on the layers (3) and (5) and under the layer (7).

4 Claims, 1 Drawing Sheet



US005109312A

United States Patent [19]

Kato et al.

[11] Patent Number: 5,109,312

[45] Date of Patent: Apr. 28, 1992

[54] MAGNETIC RECORDING APPARATUS AND MAGNETIC HEAD WITH SUPERCONDUCTING MATERIAL

[75] Inventors: Takahiko Kato, Katsuta; Jiro Kuniya, Hitachi; Takao Imagawa, Sendai; Katsuzo Aihara, Hitachiota, all of Japan

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

[21] Appl. No.: 495,095

[22] Filed: Mar. 19, 1990

[30] Foreign Application Priority Data

Mar. 20, 1989 [JP] Japan 1-66226
Jan. 17, 1990 [JP] Japan 2-6124

[51] Int. Cl.[5] G11B 5/147; G11B 5/133; G11B 5/55; H04B 3/28

[52] U.S. Cl. 360/126; 360/125; 360/106; 505/872; 505/701; 505/1

[58] Field of Search 360/126, 106, 125; 505/1, 800, 872, 701

[56] References Cited

U.S. PATENT DOCUMENTS

4,907,115	3/1990	Ruigrok et al.	360/126
4,926,082	5/1990	Barnes	360/106
4,927,804	5/1990	Zieren et al.	360/126
4,935,403	6/1990	Yamaoki et al.	346/74.2
4,937,227	6/1990	Enz et al.	360/126
4,971,947	11/1990	Barnes et al.	360/125
4,979,064	12/1990	Mage et al.	360/125

FOREIGN PATENT DOCUMENTS

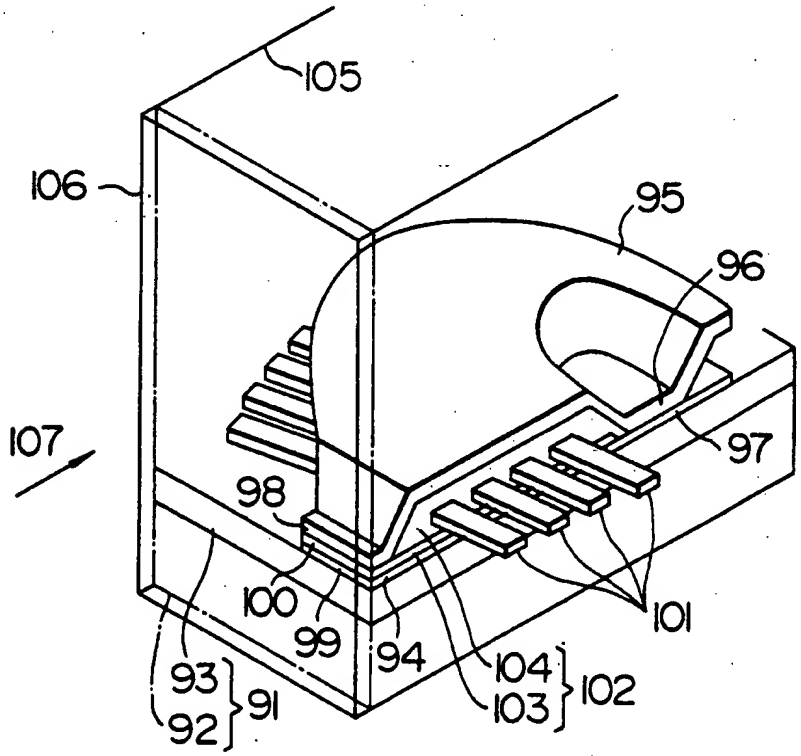
64-1139 5/1989 Japan .

Primary Examiner—John H. Wolff
Assistant Examiner—Craig A. Renner
Attorney, Agent, or Firm—Antonelli, Terry, Stout & Kraus

[57] ABSTRACT

A magnetic recording apparatus with a magnetic head, superconductive layers formed over at least flux generating surfaces of the magnetic head and normal conductive regions of small size for passing the flux provided in the superconductive layers, over the flux generating surfaces, so as not to form a closed magnetic circuit so as to enable reversible spontaneous magnetization in a magnetic recording medium proximate thereto. The minimum unit size (recording wavelength) of the reversible spontaneous magnetization in magnetic recording of the magnetic recording medium can be reduced from the order of 1 μm to that of 0.1 μm. Thus it is possible to increase the surface recording density of the magnetic recording medium utilizing more than 100 Mb/in^2, comparable to the density achieved by the opto-magnetic recording. This in turn makes it possible to provide a large disc apparatus having a capacity of 60 MB or more.

14 Claims, 7 Drawing Sheets



US005097243A

United States Patent [19]

Zieren et al.

[11] Patent Number: 5,097,243

[45] Date of Patent: Mar. 17, 1992

[54] THIN-FILM TRANSFORMER UTILIZING SUPERCONDUCTIVE COMPONENTS

[75] Inventors: Victor Zieren; Jacobus J. M. Ruigrok, both of Eindhoven, Netherlands

[73] Assignee: U.S. Philips Corp., New York, N.Y.

[21] Appl. No.: 491,393

[22] Filed: Mar. 8, 1990

Related U.S. Application Data

[63] Continuation of Ser. No. 218,013, Jul. 12, 1988, Pat. No. 4,927,804.

[51] Int. Cl.[5] H01F 5/00; H01F 36/00

[52] U.S. Cl. 336/200; 505/1; 505/870; 336/DIG. 1; 335/216; 323/360

[58] Field of Search ..... 336/200, DIG. 1, 84 R; 335/216; 323/360; 505/1, 701, 867, 868, 869, 870; 360/122, 123, 125, 126, 127, 128

[56] References Cited

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4,979,064	12/1990	Mage et al.	360/125

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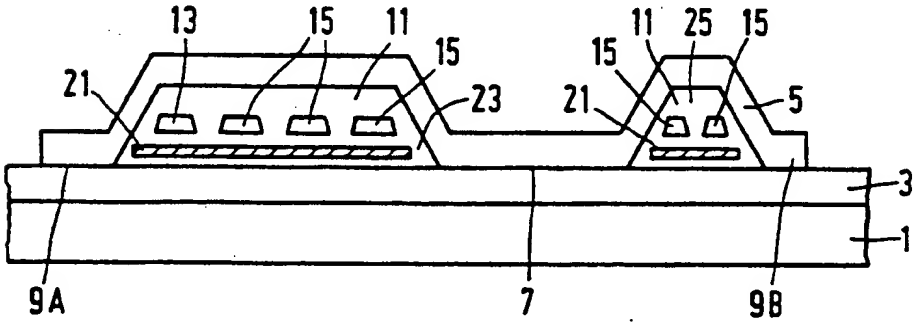
58-68210	4/1983	Japan .
1052505	12/1966	United Kingdom .
1190454	5/1970	United Kingdom .
1335472	10/1973	United Kingdom .

Primary Examiner—Leo P. Picard
Assistant Examiner—Bot Lee Ledynh
Attorney, Agent, or Firm—William L. Botjer

[57] ABSTRACT

Thin-film transformer, for example suitable for use in a thin-film magnetic head, comprising a magnetic yoke composed of two magnetically permeable thin layers **3** and **5** and a primary turn constituted by an electrically conducting thin layer **13** and a secondary turn constituted by an electrically conducting thin layer **15**. A thin layer **21** of a superconducting material is provided between the layer **3** and the said turns, or the turns are closely fitted together and made of a superconducting material themselves.

6 Claims, 2 Drawing Sheets



US005109312A

United States Patent [19]

Kato et al.

[11] Patent Number: 5,109,312

[45] Date of Patent: Apr. 28, 1992

[54] MAGNETIC RECORDING APPARATUS AND MAGNETIC HEAD WITH SUPERCONDUCTING MATERIAL

[75] Inventors: Takahiko Kato, Katsuta; Jiro Kuniya, Hitachi; Takao Imagawa, Sendai; Katsuzo Aihara, Hitachiota, all of Japan

[73] Assignee: Hitachi, Ltd., Tokyo, Japan

[21] Appl. No.: 495,095

[22] Filed: Mar. 19, 1990

[30] Foreign Application Priority Data

Mar. 20, 1989 [JP] Japan 1-66226
Jan. 17, 1990 [JP] Japan 2-6124

[51] Int. Cl.[5] G11B 5/147; G11B 5/133; G11B 5/55; H04B 3/28

[52] U.S. Cl. 360/126; 360/125; 360/106; 505/872; 505/701; 505/1

[58] Field of Search 360/126, 106, 125; 505/1, 800, 872, 701

[56] References Cited

U.S. PATENT DOCUMENTS

4,907,115	3/1990	Ruigrok et al.	360/126
4,926,082	5/1990	Barnes	360/106
4,927,804	5/1990	Zieren et al.	360/126
4,935,403	6/1990	Yamaoki et al.	346/74.2
4,937,227	6/1990	Enz et al.	360/126
4,971,947	11/1990	Barnes et al.	360/125
4,979,064	12/1990	Mage et al.	360/125

FOREIGN PATENT DOCUMENTS

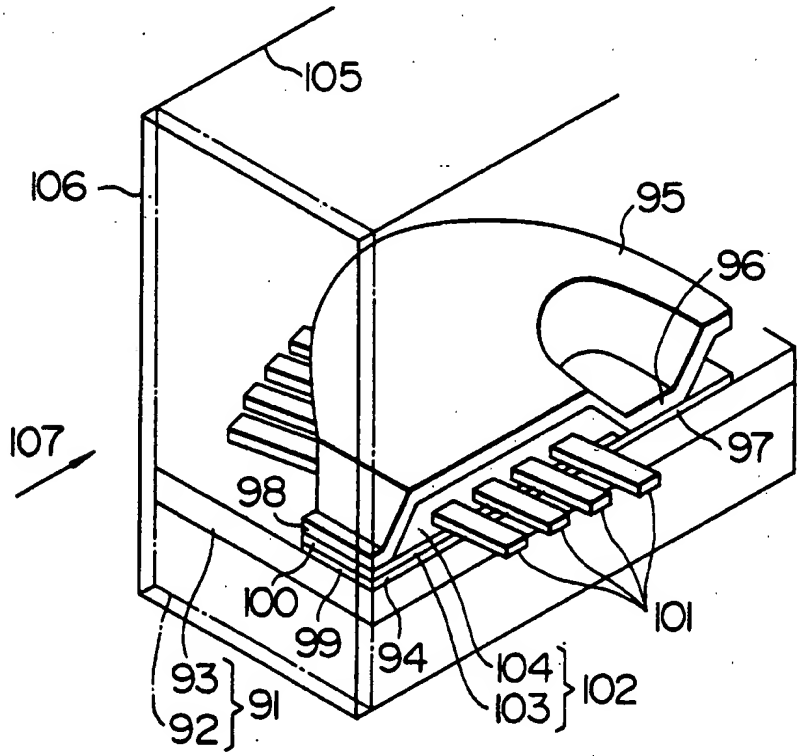
64-1139 5/1989 Japan .

Primary Examiner—John H. Wolff
Assistant Examiner—Craig A. Renner
Attorney, Agent, or Firm—Antonelli, Terry, Stout & Kraus

[57] ABSTRACT

A magnetic recording apparatus with a magnetic head, superconductive layers formed over at least flux generating surfaces of the magnetic head and normal conductive regions of small size for passing the flux provided in the superconductive layers, over the flux generating surfaces, so as not to form a closed magnetic circuit so as to enable reversible spontaneous magnetization in a magnetic recording medium proximate thereto. The minimum unit size (recording wavelength) of the reversible spontaneous magnetization in magnetic recording of the magnetic recording medium can be reduced from the order of 1 μm to that of 0.1 μm. Thus it is possible to increase the surface recording density of the magnetic recording medium utilizing more than 100 Mb/in^2, comparable to the density achieved by the opto-magnetic recording. This in turn makes it possible to provide a large disc apparatus having a capacity of 60 MB or more.

14 Claims, 7 Drawing Sheets



United States Patent [19]

Ruigrok et al.

[11] **Patent Number: 4,996,621**

[45] **Date of Patent: Feb. 26, 1991**

[54] **SUPERCONDUCTING DEVICE FOR READING INFORMATION FROM A MAGNETIC RECORDING MEDIUM**

[75] Inventors: **Jacobus J. M. Ruigrok; Victor Zieren**, both of Eindhoven; **Ulrich E. Enz**, Geldrop; **Willem F. Druyvesteyn**, Eindhoven, all of Netherlands

[73] Assignee: **U.S. Philips Corporation**, New York, N.Y.

[21] Appl. No.: **265,362**

[22] Filed: **Oct. 28, 1988**

[30] **Foreign Application Priority Data**

Nov. 2, 1987 [NL] Netherlands 8702607

[51] **Int. Cl.**[5] **G11B 5/147**

[52] **U.S. Cl.** **360/126**; 324/248; 505/845

[58] **Field of Search** 360/110, 113, 125, 126; 324/248, 249; 505/845

[56] **References Cited**

U.S. PATENT DOCUMENTS

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Primary Examiner—A. J. Heinz

Attorney, Agent, or Firm—Bernard Tiegerman

[57] **ABSTRACT**

Device is provided for reading information from a magnetic recording medium, comprising a SQUID (15), a magnetic yoke formed from two flux guides (3 and 5) and a face (13) for magnetic flux coupling of the SQUID with the magnetic recording medium. The SQUID is provided with connection means (33) for a detection circuit (35).

17 Claims, 3 Drawing Sheets